Properties of Matter

DSHS
Ellis

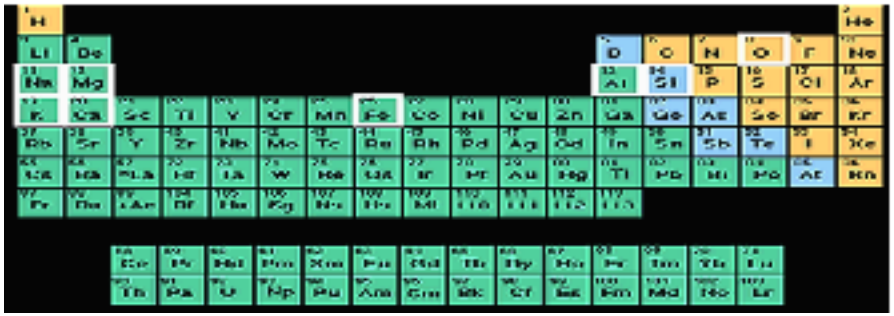
The Nature of Matter

- **Which of the following are or contain matter?**

Fish	**Idea**	**Time**	**Peanut Butter**
Desk	**Water**	**Wood**	**Silver**
Hydrogen Peroxide		**Air**	**Light**
Oxygen	**Sound**	**Memories**	**Pizza**

The Nature of Matter

I. **Matter**: anything that takes up space & has mass
   A. Types of Matter
      1. **Pure substance**: substance that contains ONE kind of particle
         a. **Element**: single substance that cannot be broken down



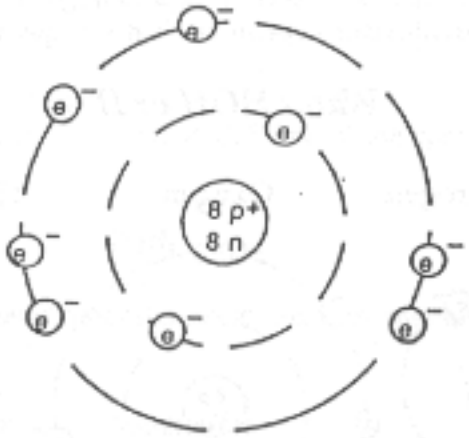
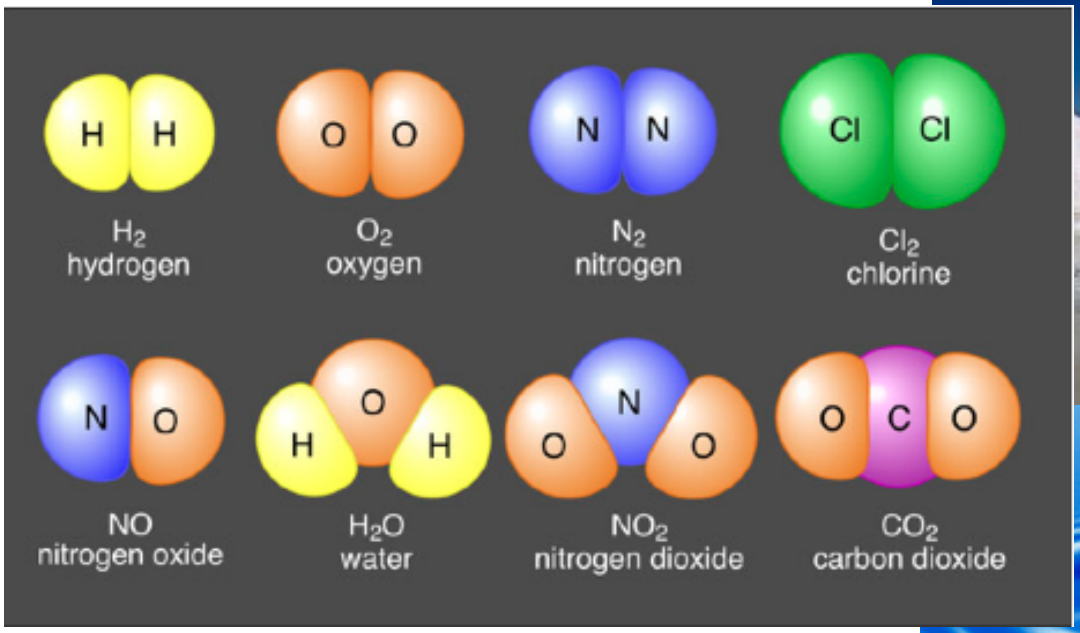
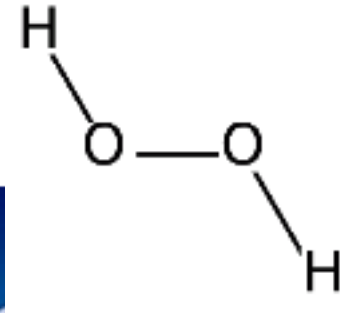


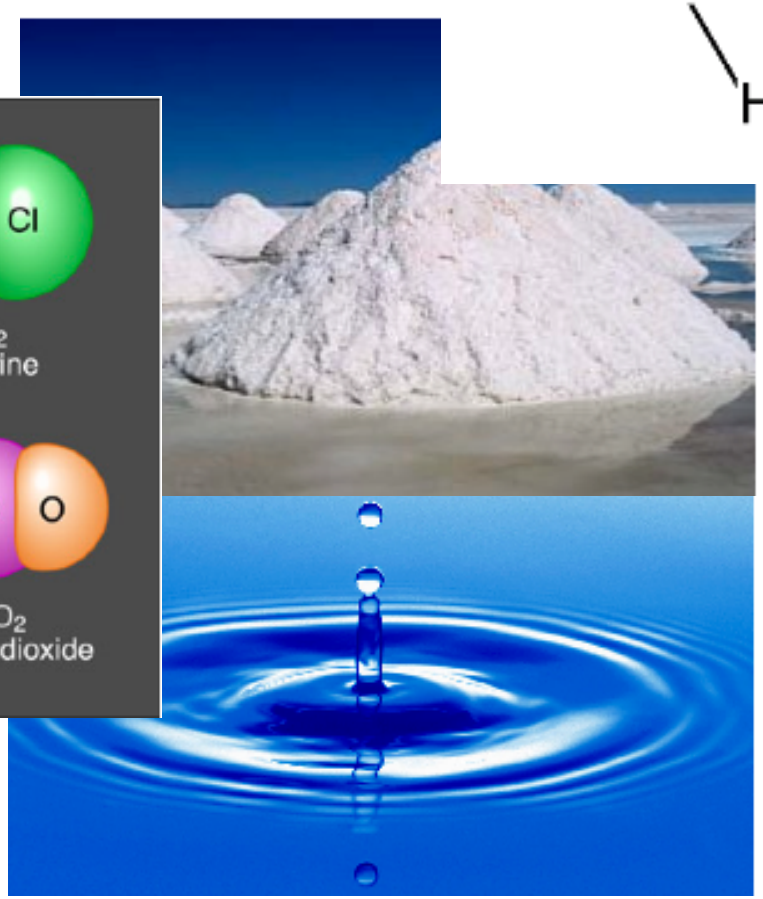
Figure 5. Oxygen atom

The Nature of Matter

b. **Compound**: two or more substances / elements that can not be easily broken down

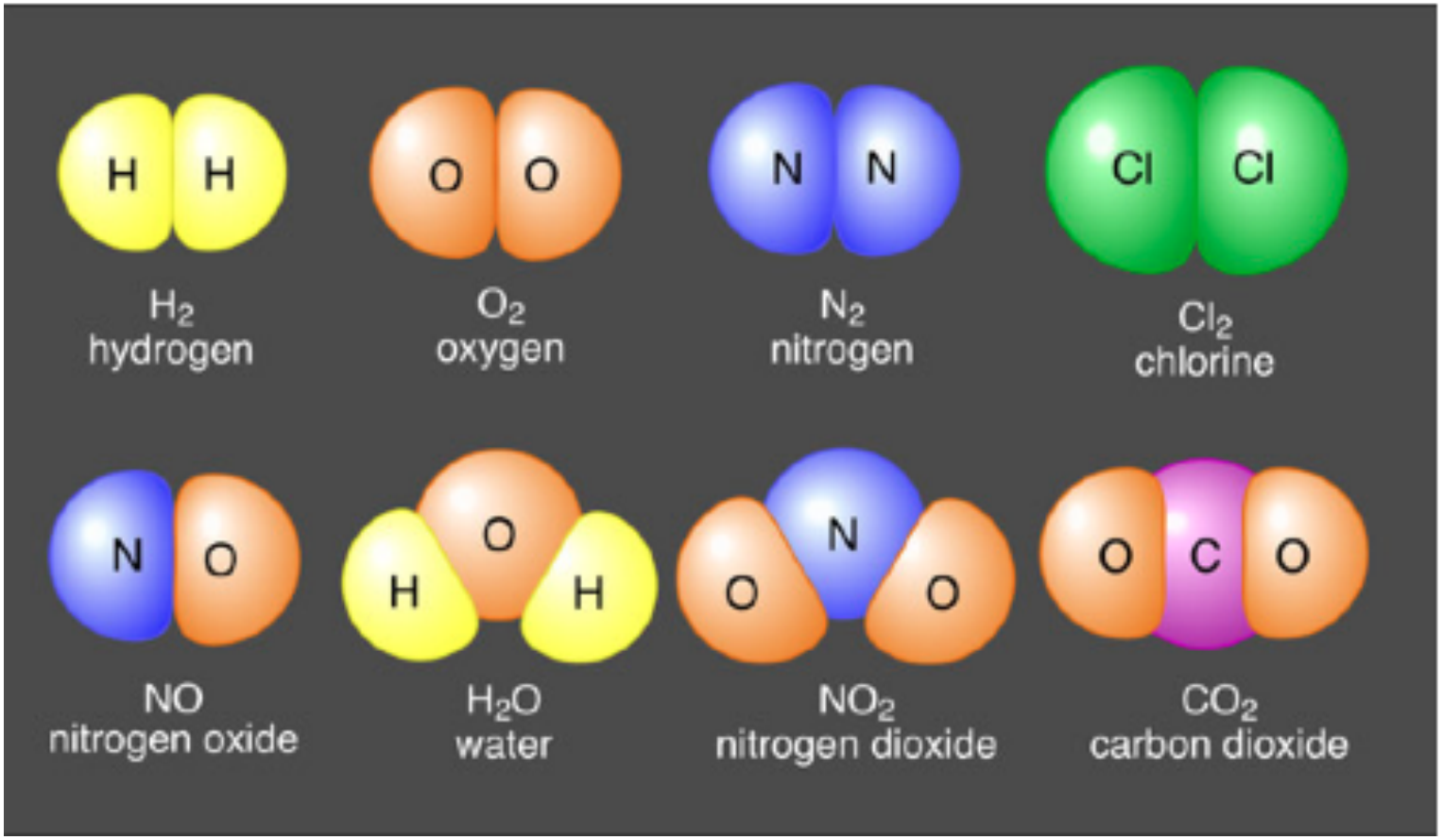


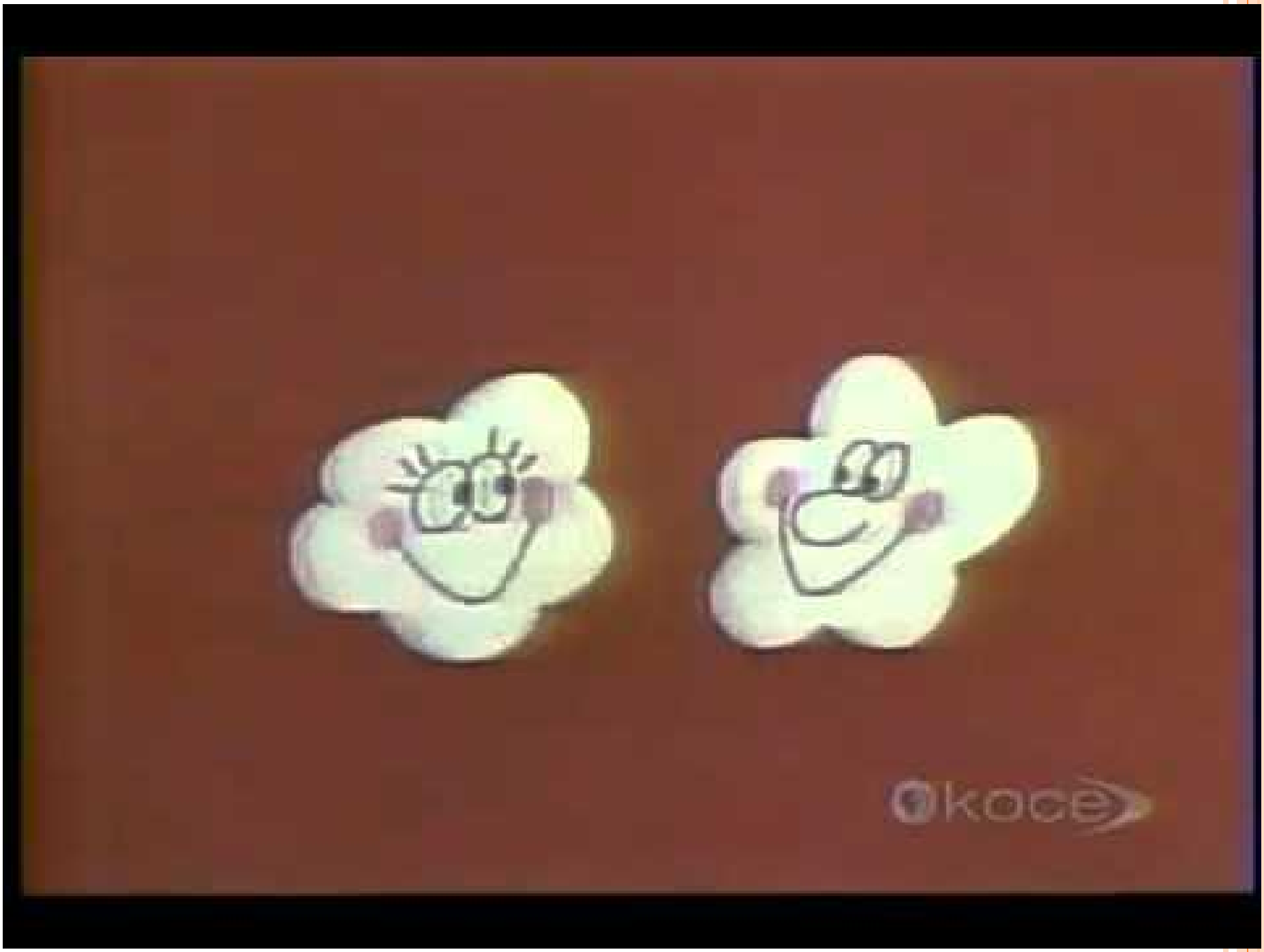




The Nature of Matter

i. **Molecule**: The smallest particle (one or more atoms) of a compound that has all the properties of that compound

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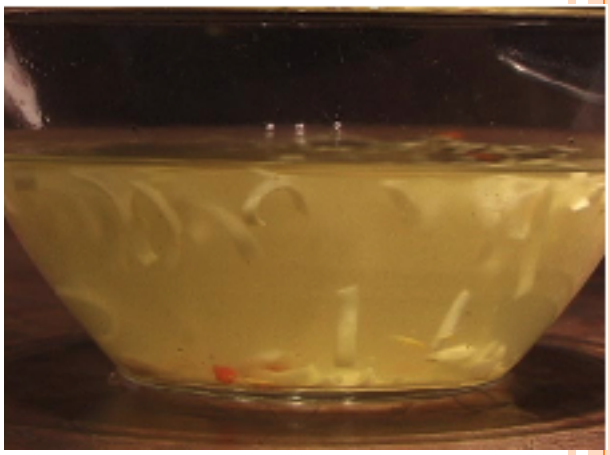
The Nature of Matter

2. **Mixture**: Combination of substances that can be easily broken down

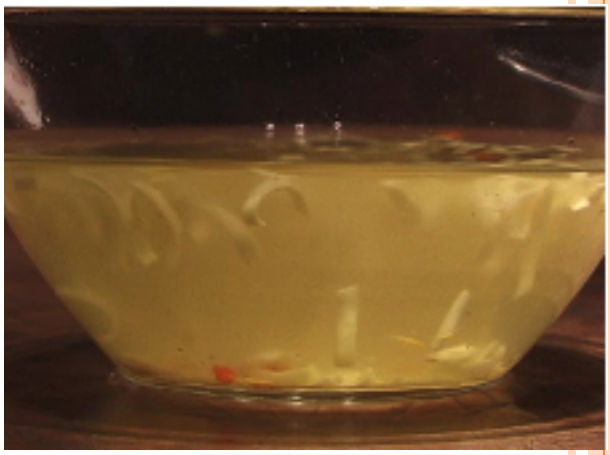
The Nature of Matter

a. **Heterogeneous**: items can be easily identified
   i. **Suspension**: mixture in which particles can be seen and easily separated by settling or filtration
      - Mixtures which separate out into layers
      - Liquids which must be shaken well
      - Particles are large



The Nature of Matter

a. **Heterogeneous**: items can be easily identified
   i. **Colloid**:
      - Mixtures which does not separate out into layers
      - Particles are medium



The Nature of Matter

b. **Homogeneous**: items are uniform
   i. **Solution: A homogeneous mixture which does not separate into layers**
      b **Can see through liquid solutions**
      b **Particles are small**
   ii. **Solvent**
   iii. **Solute**

The Nature of Matter

- **Classifying the following types of matter?**

Fish

E – C – M

Peanut Butter

E – C – M

Desk

E – C – M

Water

E – C – M

Wood

E – C – M

Silver

E – C – M

Hydrogen Peroxide

E – C – M

Air

E – C – M

Oxygen

E – C – M

Pizza

E – C – M

The Nature of Matter

- What are some properties of this piece of matter?

The Nature of Matter

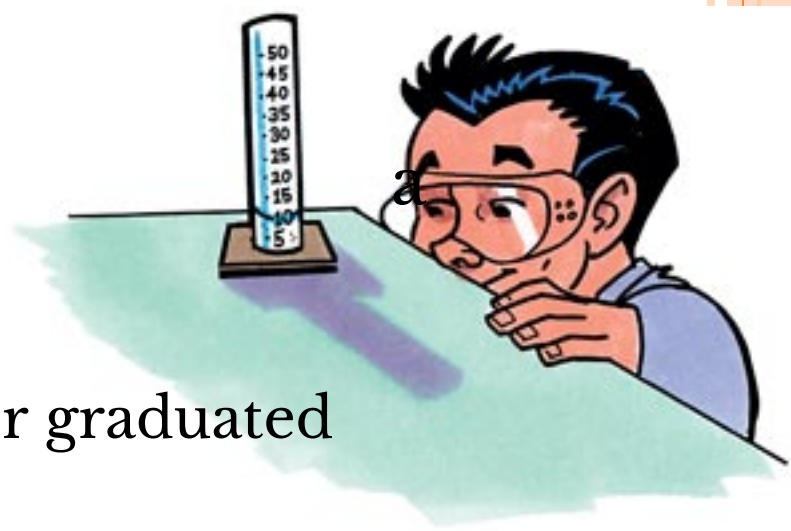
B. Properties of Matter
   1. **Extensive**: depend on amount present.
      a. Mass: amount of matter in object (measured in grams [g])
      b. Weight: gravitational force acting an object (measured in newtons [N])
      c. Volume: amount of space a substance occupies (measured in liters [L] if a liquid or cubed meters [m^3] if a solid)
      d. Length (measured in meters [m])

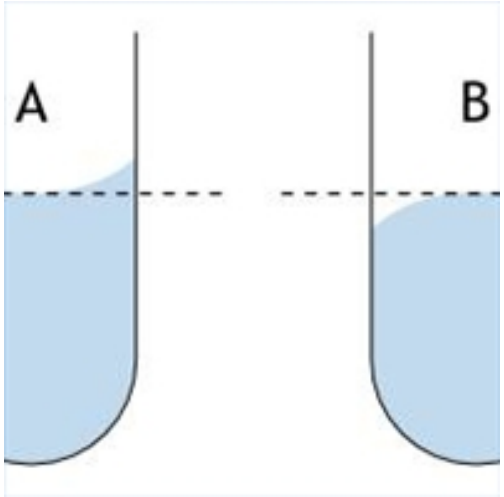
The Nature of Matter

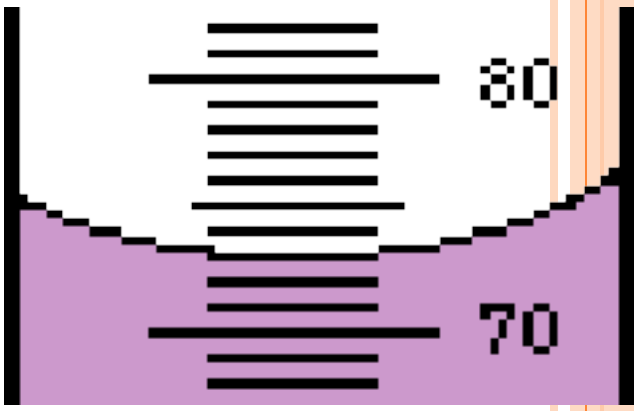
2. **Intensive**: constant throughout material
   a. Color
   b. Odor
   c. Luster: How shiny a substance is.
   d. Malleability: The ability to be beaten into thin sheets.
   e. Ductility: The ability to be drawn into wires.
   f. Conductivity: Allows the flow of free electrons. Electricity can move through the material.
   g. Hardness: How easily it is scratched.
   h. Melting / Freezing / Boiling Point
   i. Density

The Nature of Science

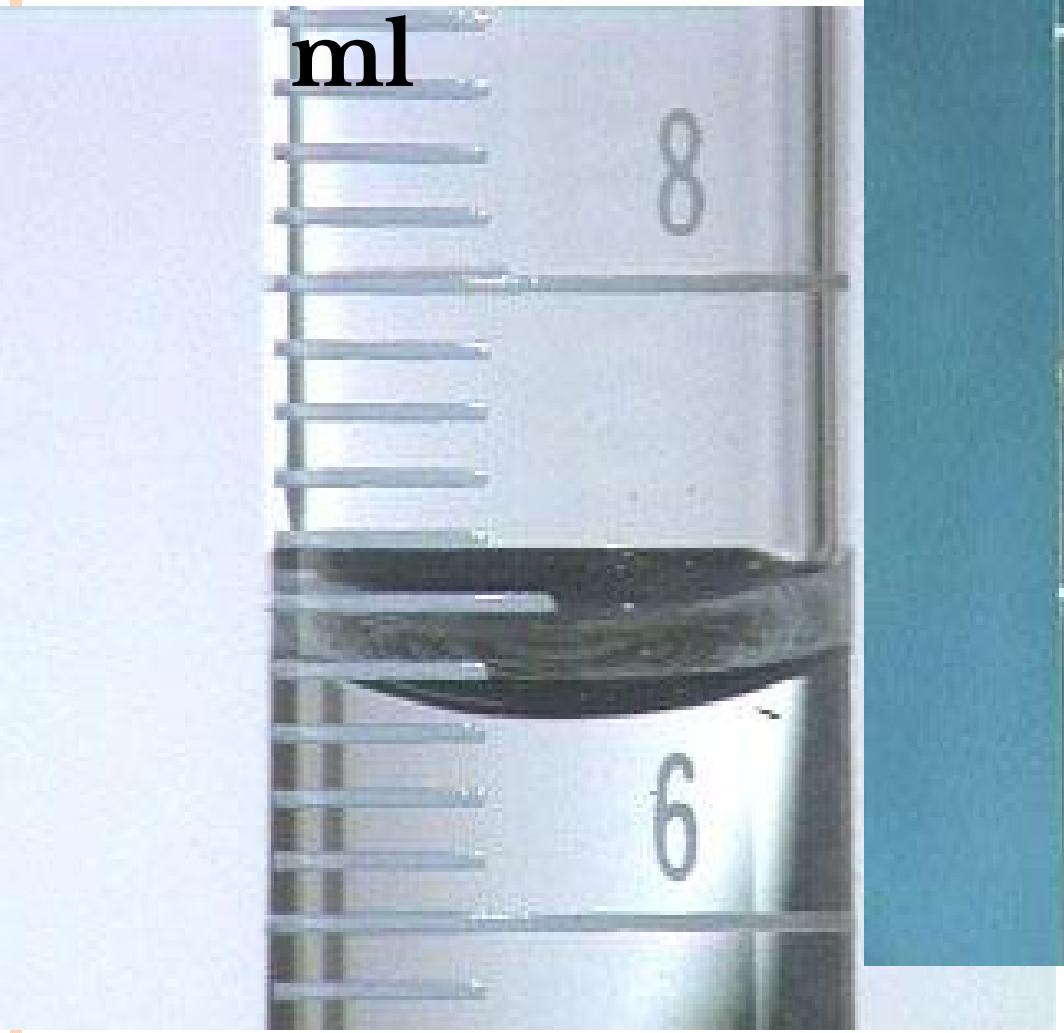
B. Volume: amount of space substance occupies.
   1. Base unit: liter (L).
   2. Tools: metric ruler (solids) or graduated cylinder (liquids).

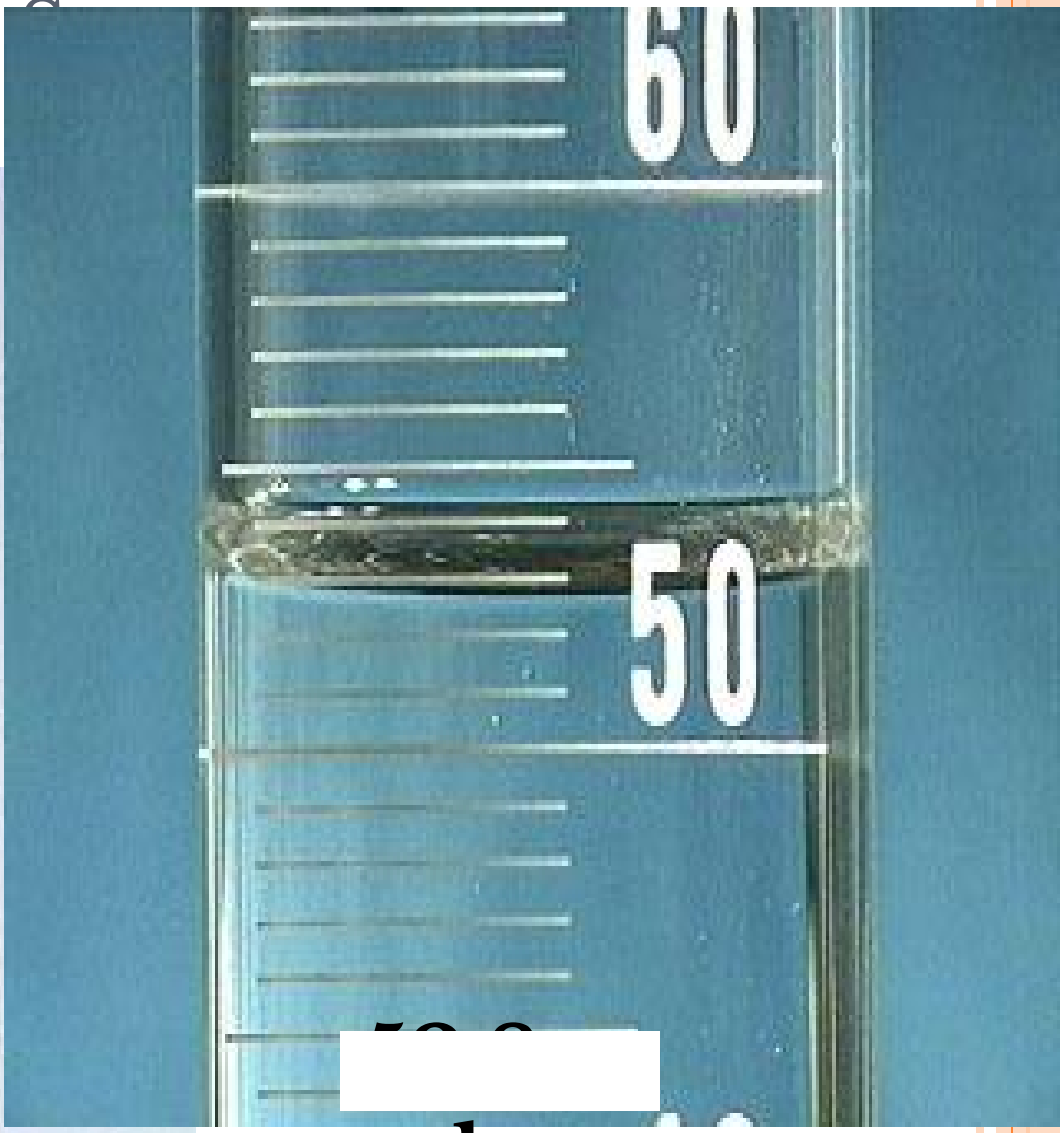






The Nature of S





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The Nature of Matter

II. **Density**: amount of matter contained by a given volume

$$D = \frac{m}{V} = \frac{mass}{volume}$$

The Nature of Matter

Finding Density

Calculate the density of a material that has a mass of 52.457 g and a volume of 13.5 cm^3

The Nature of Matter

Finding Density

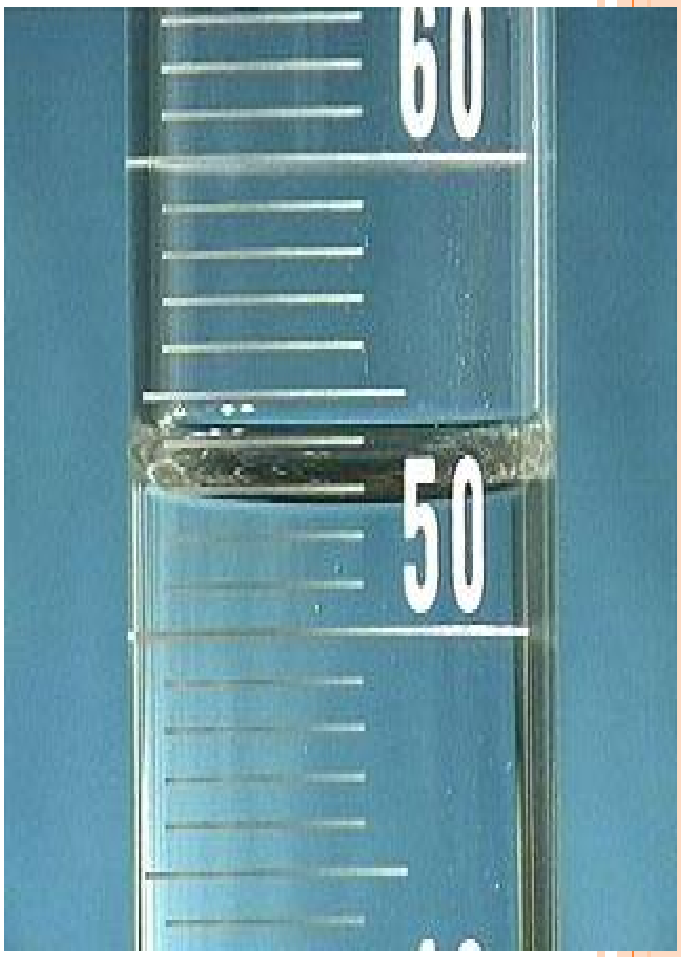
Calculate the density of a gold that has a mass of 2.2 kg and a volume of 113.9 cm^3

kilo	hecto	deca	meter liter gram	deci	**centi**	**milli**

The Nature of Matter

Finding Density

Find the density of an object that has a mass of 0.013 kg and is placed in a graduated cylinder that originally has a volume of 48.3 mL



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Finding Mass

- The density of silver is 10.49 g/cm^3. If a sample of pure silver has a volume of 12.993 cm^3 what would the mass be?

The Nature of Matter

Finding Volume

- Pure gold has a density of 19.32 g/cm^3. How large would a piece of gold be if it had a mass of 318.97 g?

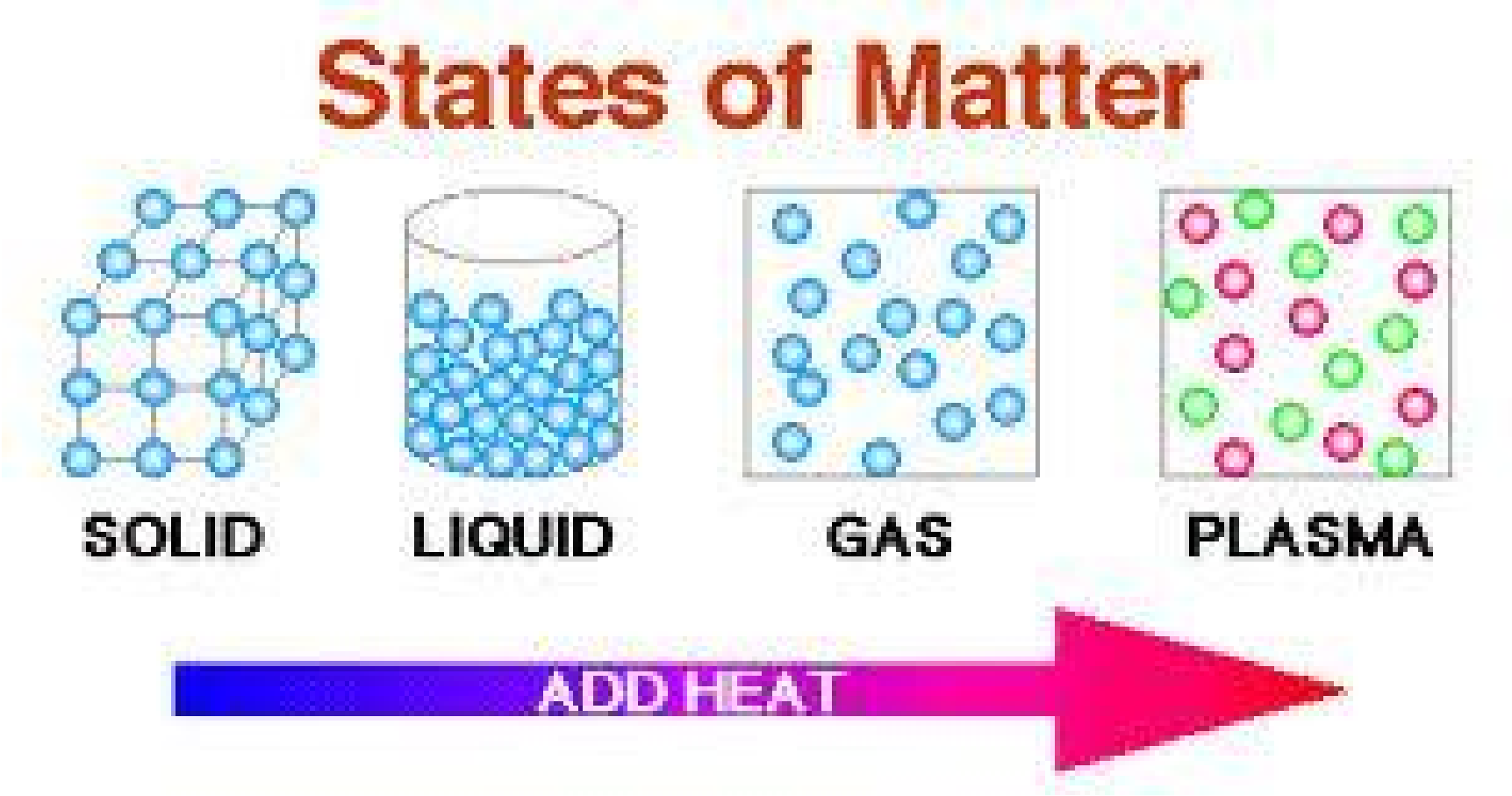
The Nature of Matter

A. An object's buoyancy is determined by its density in relation to the density of the surrounding liquid.
   1. If the object is more dense than liquid = sink
   2. If the object is less dense than liquid = float

http://www.youtube.com/watch?v=EBcJXEHjnw8&feature=related

The Nature of Matter

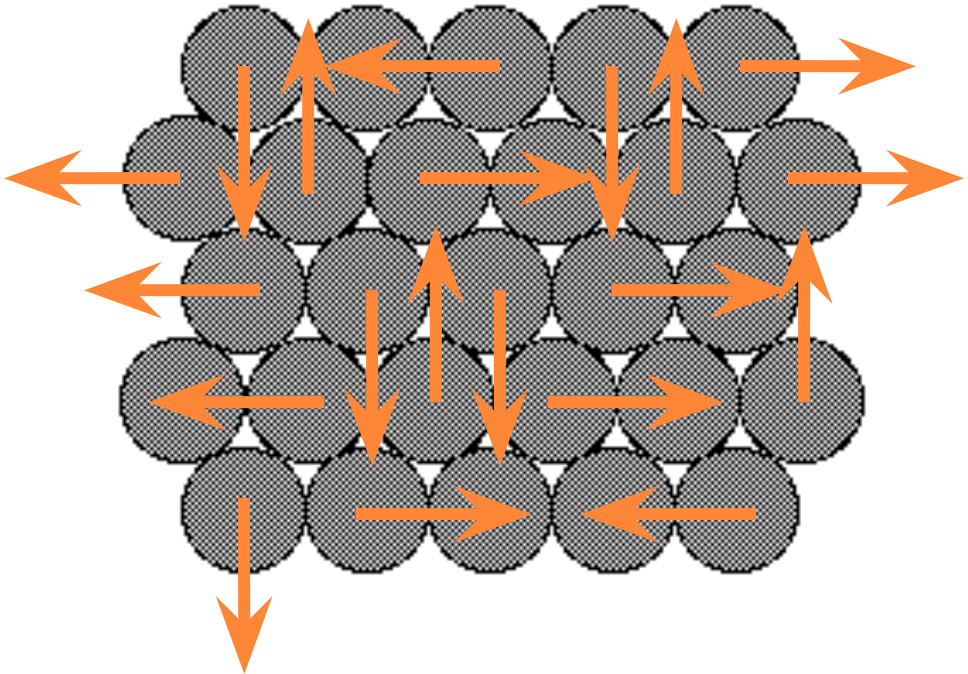
III. States of Matter: determine if shape / volume are definite or variable.



The Nature of Matter

A. Solids

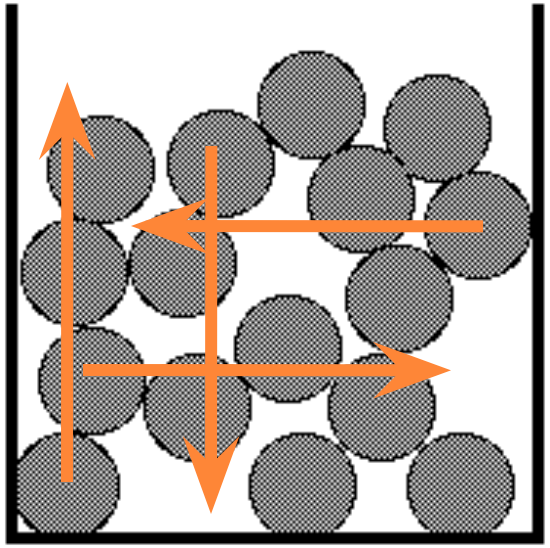
1. definite shape & volume
2. Particles held tightly together, and vibrate in place



The Nature of Matter

B. Liquids

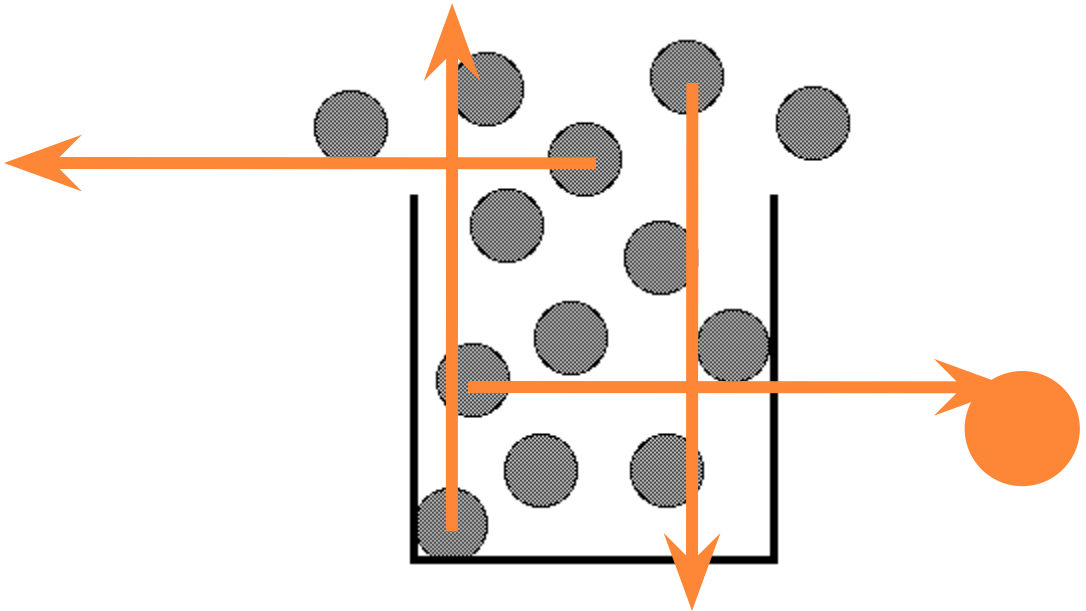
1. Changing shape, definite volume
2. Particles move rapidly, allows them to overcome attractive forces between them



The Nature of Matter

C. Gases

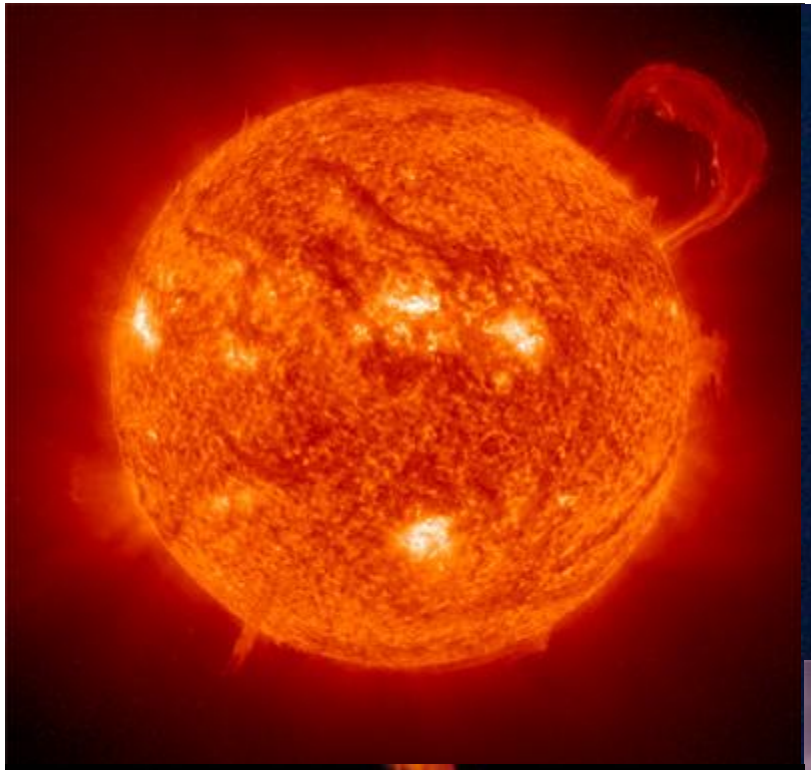
1. Changing shape and volume
2. Particles move fast and break away from each other. Amount of space b/t particles changes and gas expands to fill the space

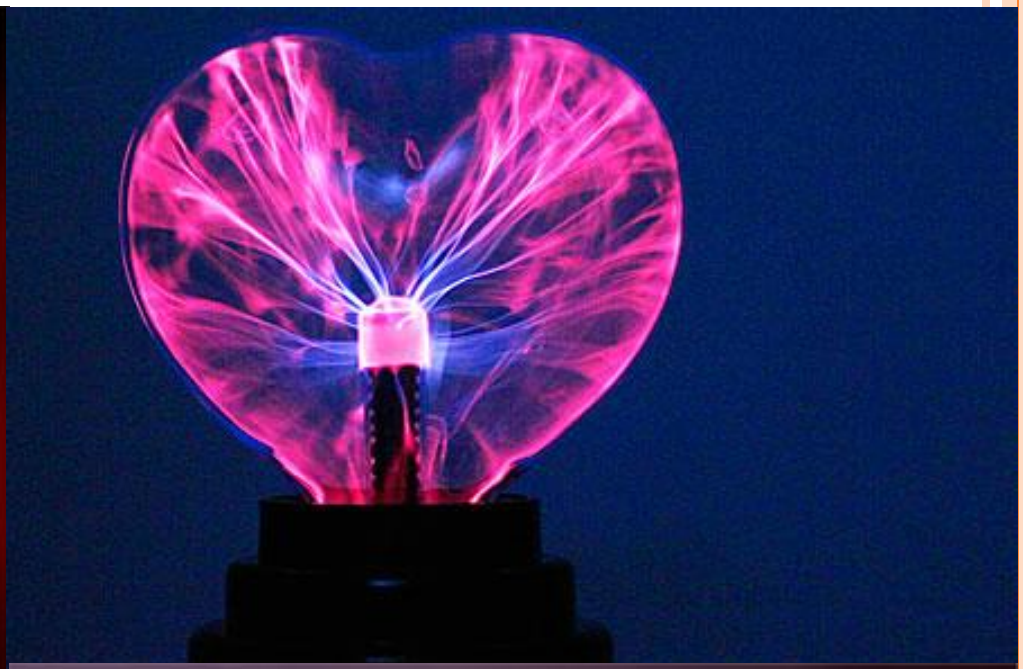


The Nature of Matter

D. Plasma

1. No definite shape or volume,
2. Particles are electrically charged
3. Examples: lightning, fire, and aurora borealis





The Nature of Matter

E. **Bose-Einstein Condensates**: superconductors or superfluids

1. Superconductors are materials that are cooled to almost absolute zero which result in no resistance to the flow of electricity.

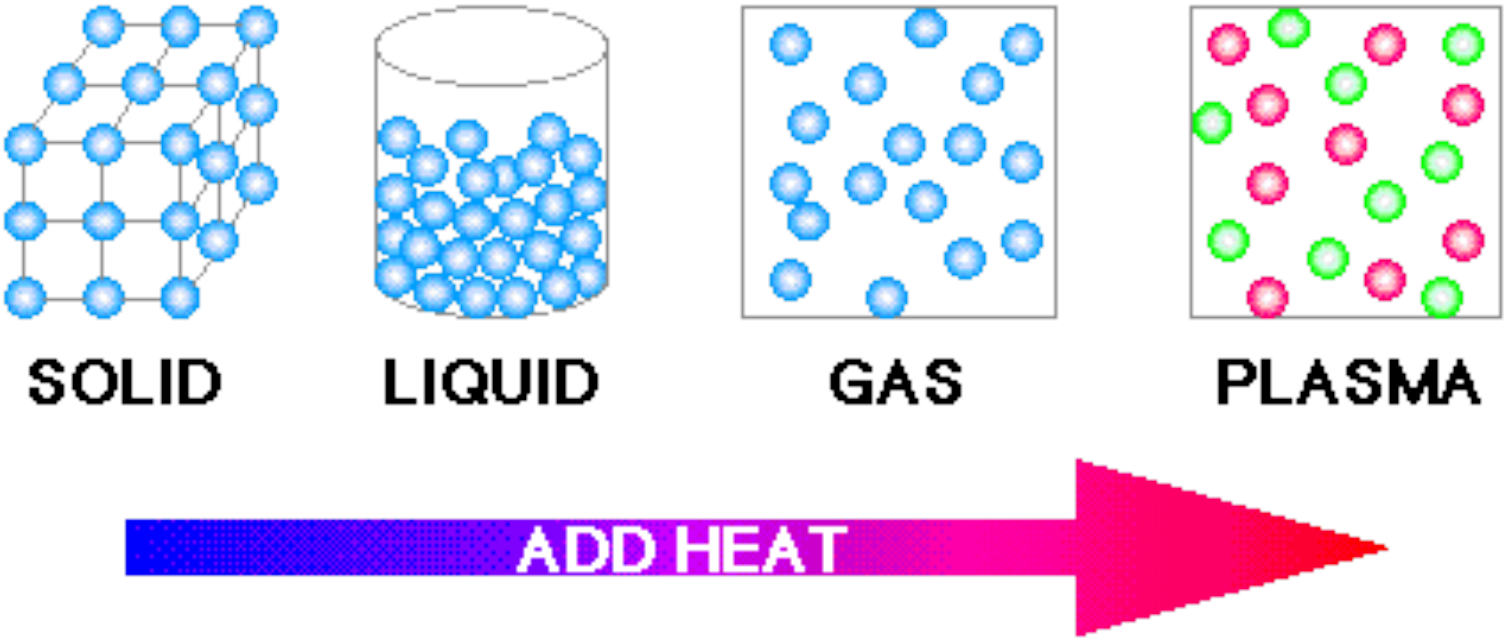
2. Superfluids, liquid helium, can trap light and slow the speed of light.

The Nature of Matter

F. EXCEPTIONS?!?!

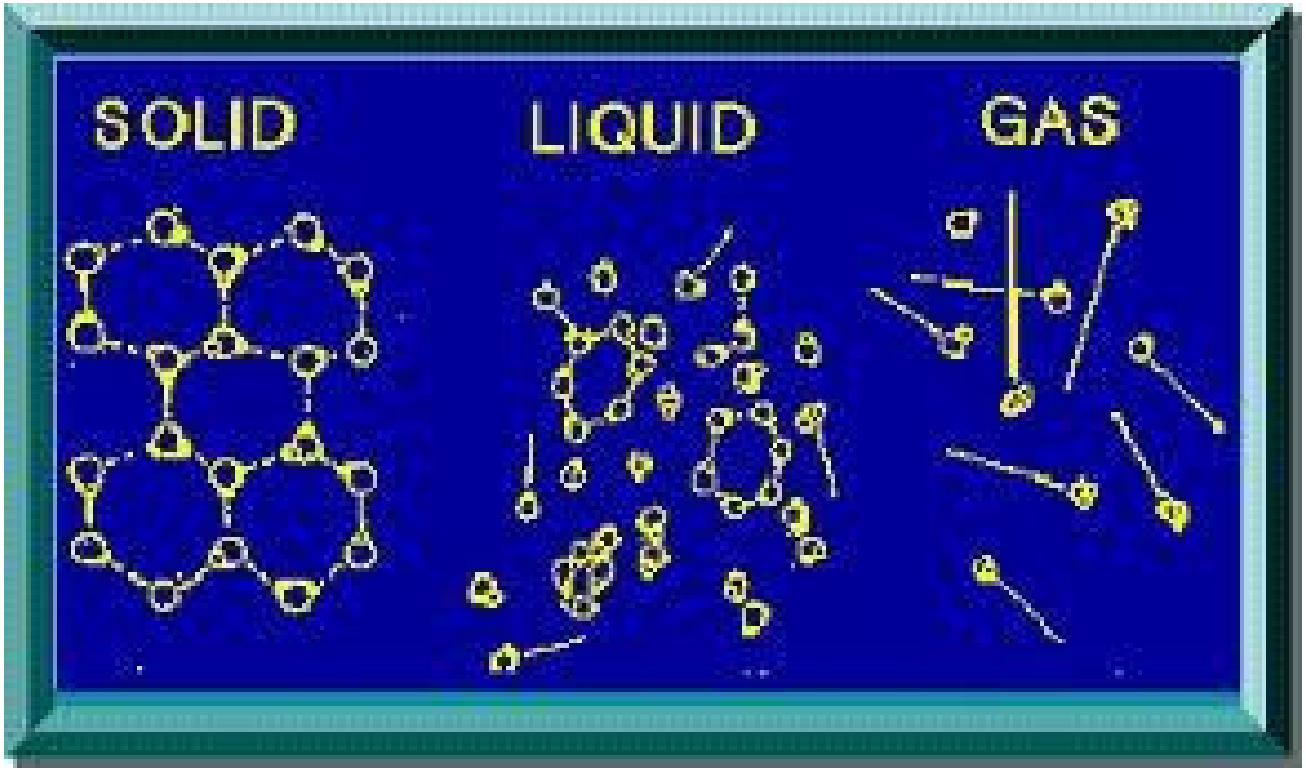
1. Amorphous Solids
   a. Solids that have no regular shape, often described as supercooled liquids
   b. Examples: rubberbands, butter, cotton candy, glass

States of Matter



The Nature of Matter

IV. Kinetic Theory of Matter: matter is made of atoms / molecules that act like tiny particles in motion



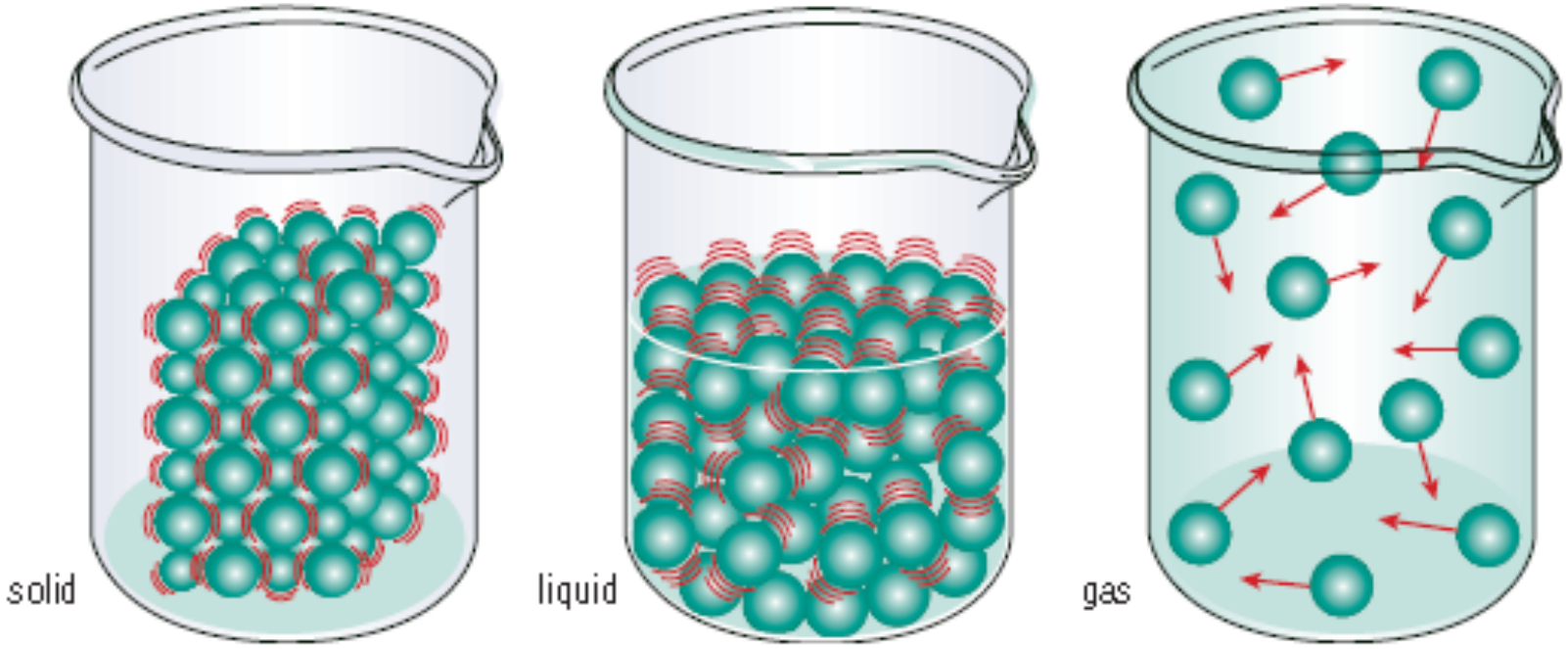
The Nature of Matter

A. Particles in motion:
   1. Higher temperature of a substance = faster the particles move
   2. At the same temperature, more massive particles move slower then less massive ones

The Nature of Matter

V. Temperature: measure of the kinetic energy of the particles in an object

A. Particles of matter are constantly moving, but not always moving at the same speed



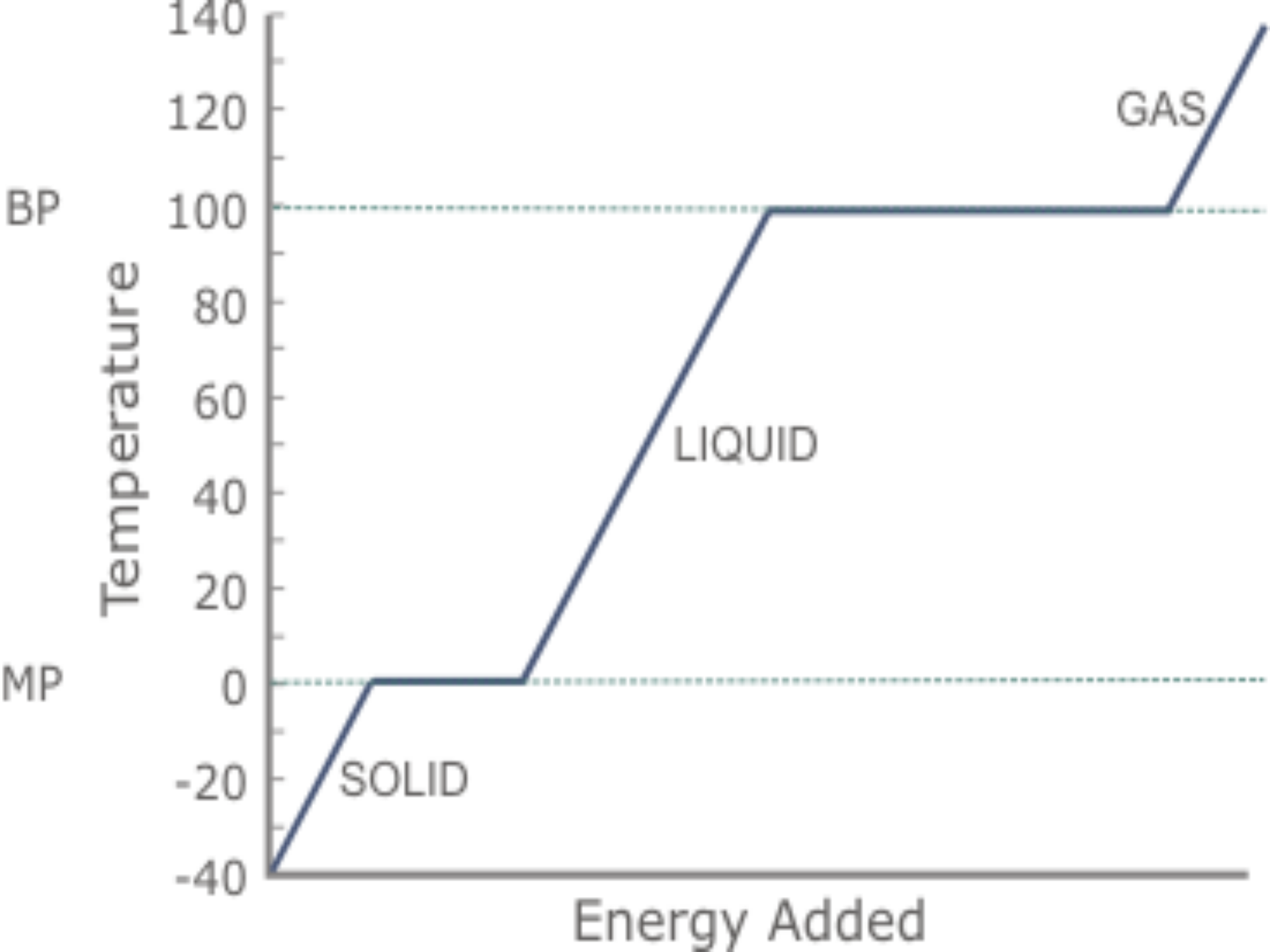
Particles in solids, liquids and gases vibrate. Those in liquids and gases are also able to change position.

Fig 2.1.2

The Nature of Matter

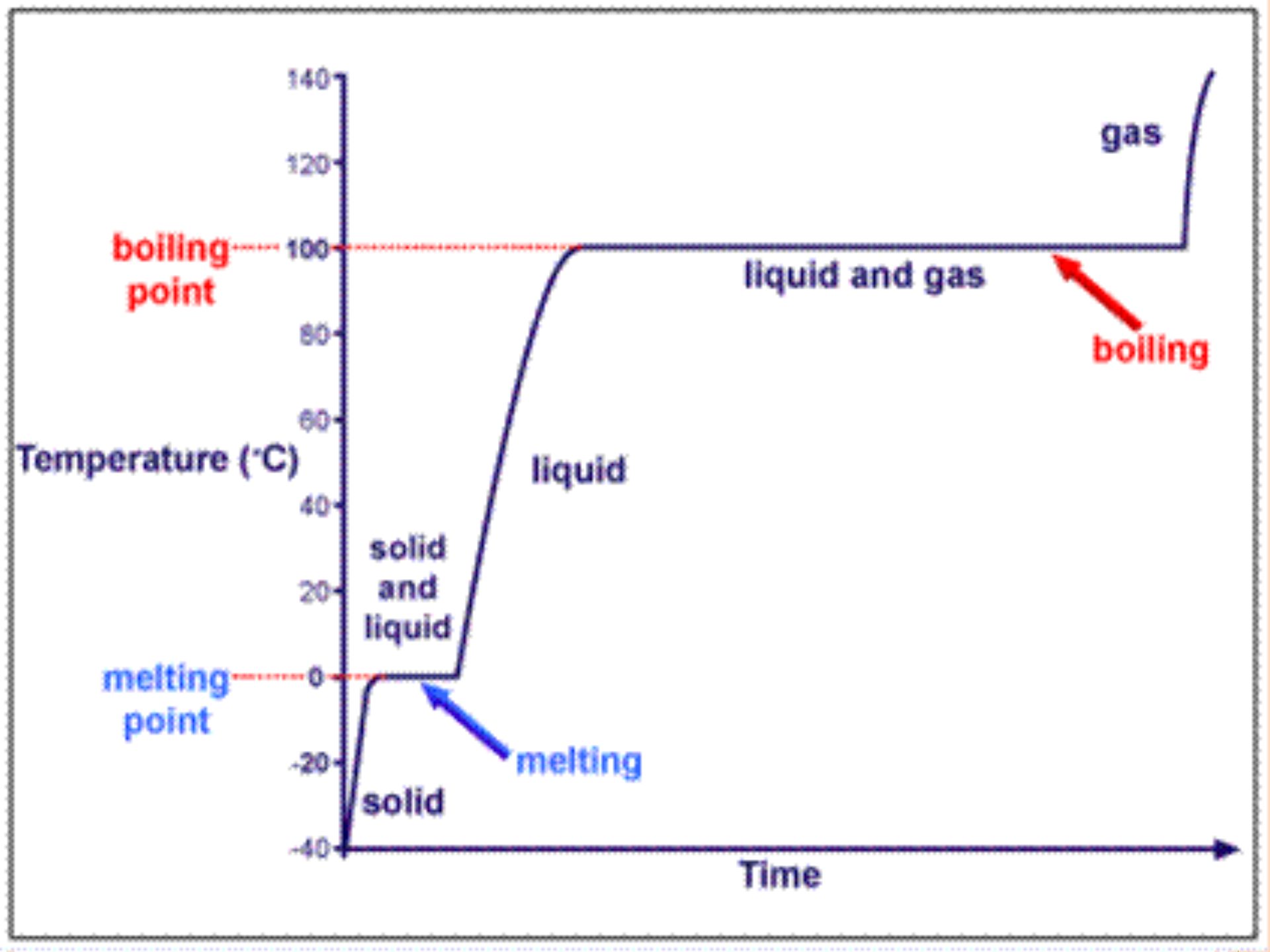
VII. Energy and Changes of State

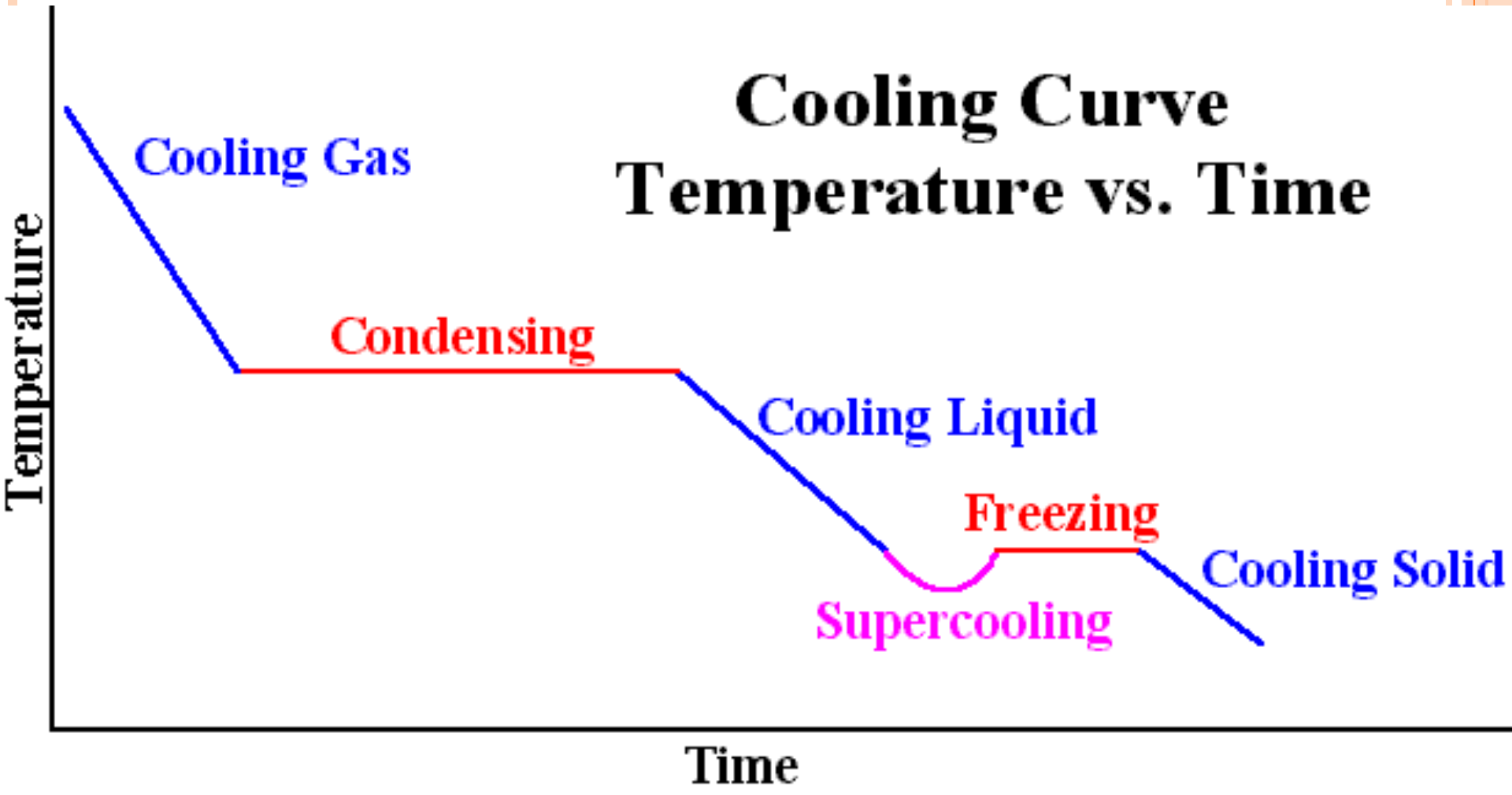
A. Identity of a substance does not change during a change of state, but energy does
   1. If you add energy, particles move faster
   2. If you remove energy, particles slow down


140
120
BP
100
80
60
40
20
MP
0
-20
-40
Temperature
GAS
LIQUID
SOLID
Energy Added

The Nature of Matter

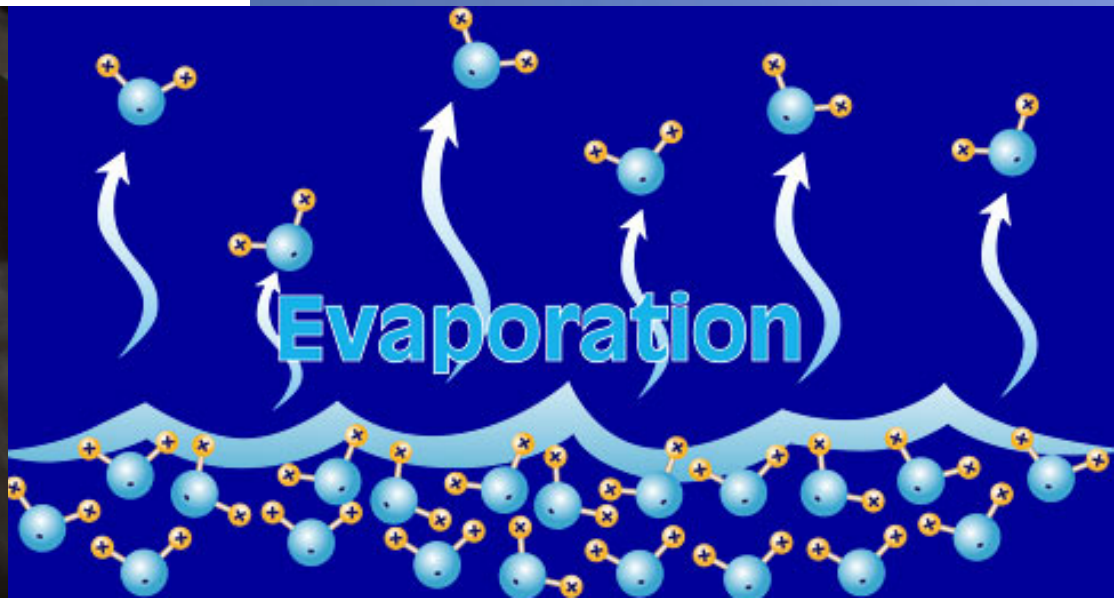
- Kinetic Energy increases / decreases as a material heats up / cools down
- Potential energy increases / decreases as a material goes through a phase change.


140
120
100
80
60
40
20
0
-20
-40
boiling point
melting point
Temperature (°C)
gas
liquid and gas
boiling
liquid
solid and liquid
melting
solid
Time


Cooling Curve
Temperature vs. Time
Cooling Gas
Condensing
Cooling Liquid
Freezing
Supercooling
Cooling Solid
Temperature
Time

The Nature of Matter

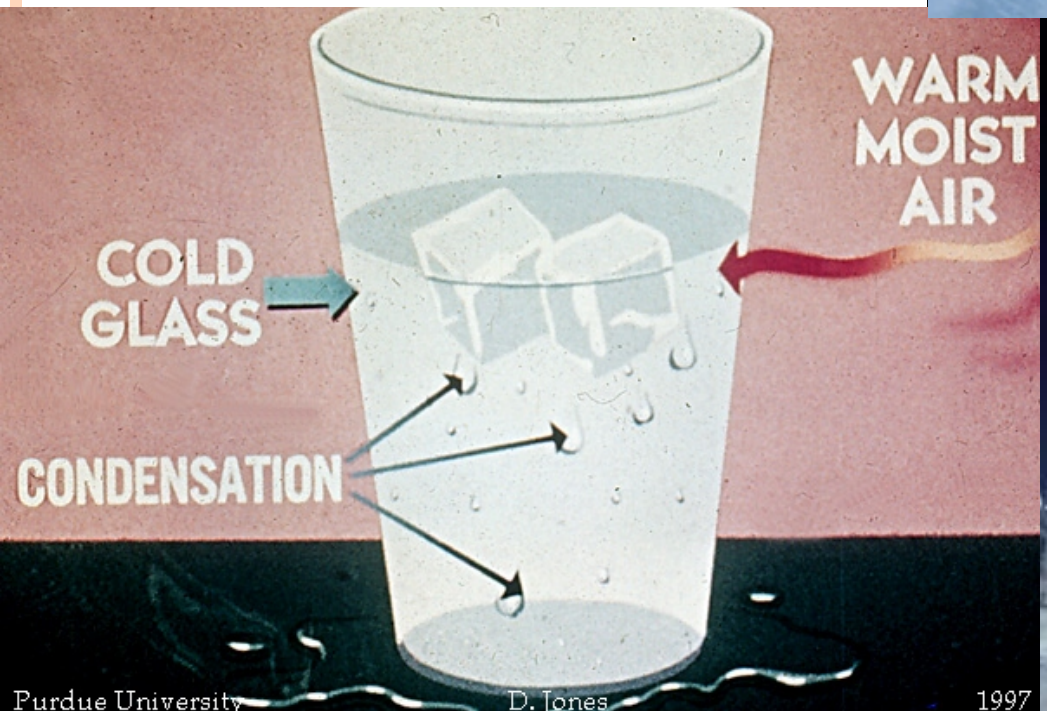
Melting
Vaporization
Sublimation



* Melting, Vaporization, and Sublimation all **require** energy

The Nature of Matter

Condensation
Freezing
Deposition



- Energy is **released** in condensation, freezing and deposition

The Nature of Matter

Difference between physical and chemical change.

- **Physical Change**: Substance may seem different, but the way the atoms link up is the same.
  - When something turns into a _____ mixture as salt water
  - It changes shape, size, or physical _____.
  - It _____.